

REMARKS

In the final office action mailed May 18, 2004, the Examiner:

- rejected claims 1, 4-12, 14, 16 and 22 under 35 U.S.C. 102(e) as being anticipated by Subramanian (US Patent Application No. 2004/0070069, newly cited);
- rejected claims 2, 13, 15, 23 and 26 under 35 U.S.C. 103(a) as being unpatentable over Subramanian as applied to claim 1; and
- rejected claim 3 under 35 U.S.C. 103(a) as being unpatentable over Subramanian as applied to claims 1-2, and further in view of Caletka (U.S. Patent No. 6,410,988).

With this response, the pending claims are claims 1-16 and 22-26.

Claim Rejections - 35 U.S.C. 102(e)

Claim 1, as amended, recites an electronic package that comprises a substrate, an electronic device attached to a surface of the substrate, and a heat spreader covering the device and having two parallel sidewalls attached to the substrate surface along two opposite edges of the substrate. In particular, the electronic device has two long edges and two short edges, each one being parallel to one of the substrate edges. Each of the two short device edges is substantially closer to its parallel substrate edge than each of the two long device edges is to its parallel substrate edge. As a result, there is more space on the substrate between the two long device edges and their respective parallel substrate edges than between the two short device edges and their respective parallel substrate edges for receiving the two parallel sidewalls of the heat spreader.

Applicant's channel heat spreader has a significant advantage over prior art heat spreaders when used in an ultra large die-to-package ratio (ULDPR) flip-chip package. For example, if the die is rectangular and the substrate is square, there is more free space left on the substrate surface in one of the two orthogonal directions than the other one after the die is attached to the substrate. Applicant's channel heat spreader, with its two sidewalls attached to the two sides of the substrate that have more free space, is more flexible than a 4-side heat spreader in leveraging the free space left on the substrate and more effective than a 4-corner heat spreader in reducing the substrate warpage. *See* page 3, lines 22-28, and page 6, lines 8-10 of the present application.

In contrast, Subramanian does not disclose an electronic device having two long edges and two short edges. Instead, Fig. 7 of Subramanian discloses a square chip 14 on a

square surface of a substrate 12. Therefore, the free space left on the substrate surface is evenly distributed along the four sides of the substrate and there does not exist two opposite sides that have substantially more space than the other two. Fig. 7 also shows that the size of the chip 14 is significantly smaller than that of the substrate 12, and it is even possible to position four chips having sizes similar to that of the chip 14 on the substrate 12 with sufficient room left for hosting the lid 100. There is no teaching or suggestion in Subramanian that the lid 100 is intended to be used in the context of an ULDPR package to reduce the substrate warpage. Actually, there is no mention of the issue of substrate warpage in Subramanian at all and the only advantage that Subramanian accredited to a lid like the lid 100 is that it is easier to manufacture. *See* paragraph 0037 of Subramanian.

In view of aforementioned reasons, applicant believes that claim 1 and its dependent claims 4-12, 14 and 16 are not anticipated by Subramanian. Since claim 22 recites substantially a similar set of limitations as claim 1, claim 22 is not anticipated by Subramanian for at least the same reasons discussed above.

Claim Rejections - 35 U.S.C. 103(a)

A specific application of the present invention is to an ULDPR package in which the package warpage is a challenging issue that has a serious impact on the durability of the package and the channel heat spreader has a clear advantage over the conventional 4-side or 4-corner heat spreaders. Claims 2 and 23 recite that the electronic device is a rectangle while the substrate is a square, and the orientation of the electronic device therefore directly decides the orientation of the heat spreader in which the package warpage is maximally reduced. Furthermore, claims 13 and 26 recite that the width of each sidewall of the heat spreader is about 2mm and claim 15 recites that the dimensional difference between the electronic device and the substrate in at least one direction is smaller than 7mm to highlight that the present application is specifically designed for the ULDPR package.

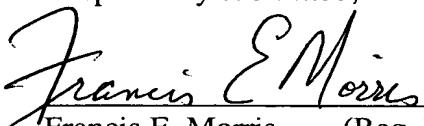
Figs. 5-7 of Subramanian, however, teach a square chip 14 attached to a substantially larger (e.g., 35mm by 35mm) square substrate 12 and covered by a substantially larger (e.g., 35mm by 35mm) square lid 100. Every dimension of the lid 100 is disclosed in Subramanian except the width of the rails 112 and 114 (see paragraph 0030). This, in combination with the figures, clearly demonstrates that the orientation of the chip 14 has no effect on the orientation of the lid 100 and the Subramanian package is not designed for receiving a rectangular chip that has at least one dimension very close to the dimension of the substrate.

In summary, Subramanian not only fails to disclose the dimensions recited by claims 13, 15 and 26 (as acknowledged by the Examiner), but also lacks motivation for one skilled in the art to modify its teaching of a package that includes a square-shaped substrate and a substantially smaller square-shaped chip to solve the issue of package warpage inherent in the ULDPR package. Therefore, claims 2, 13, 15, 23 and 26, which ultimately depend from either claim 1 or 22, are patentable over Subramanian for at least the same reasons discussed above.

Nor does Caletka disclose an electronic device having two long edges and two short edges or a heat spreader with a lid and two parallel sidewalls. Actually, since Caletka provides only cross-sectional views of a flip-chip package (e.g., Figs. 3 and 5-7), it is reasonable to conclude that the semiconductor chip 12 is actually a square and the thermally conductive member 22 is a flat plate without any sidewall. Therefore, Caletka does not remedy the deficiency of Subramanian discussed above.

In view of the foregoing, applicant believes that all of the claims are now in condition for allowance and respectfully requests the Examiner to pass the subject application to issue. If for any reason the Examiner believes any of the claims are not in condition for allowance, he is encouraged to phone the undersigned attorney at (650) 849-7777 so that any remaining issues may be resolved. No additional fee is believed due for filing this response. However, if a fee is due, please charge such fee to Morgan, Lewis & Bockius LLP Deposit Account No. 50-0310.

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Respectfully submitted,

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